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A PROJECT FOR THE IMPROVED USE OF NEWER EDUCATIONAL MEDIA IN
ELEMENTARY SCHOOL MATHEMATICS.

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THE PURPOSE OF THIS PROJECT WAS TO RELATE ELEMENTARY
SCHOOL MATHEMATICS TO EDUCATIONAL MEDIA BY IDENTIFYING THE
OBJECTIVES, CONCERNS, AND PROBLEMS OF THIS AREA, AND
PROVIDING SPECIFICATIONS AND RECOMMENDATIONS FOR THE USE AND
DEVELOPMENT OF NEWER EDUCATIONAL MEDIA. TWO POSITIONAL
CONFERENCES WERE HELD WITH EXTENSIVE POSITIONAL PAPERS
PREPARED BY SPECIALISTS IN EACH AREA. GROUP DISCUSSIONS WERE
CONDUCTED BY THE PARTICIPANTS AND "GROUP POSITIONS" REACHED.
THE RECOMMENDATIONS WERE (1) TO PROVIDE OPPORTUNITIES FOR
PERSONNEL TO OBTAIN EXPERIENCE IN THE DEVELOPMENT OF
INSTRUCTIONAL SYSTEMS AND (2) TO DETERMINE A STRUCTURE FOR
INTERACTION BETWEEN THEM AND SPECIALISTS. (R5)

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Sponsored by

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and

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Title VII of P. L. 85-864

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Contract No. OE-4-16-016

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FINAL REPORT

James H. Zant, Project Director

Department of Mathematics

Oklahoma State University

Stillwater, Oklahoma

August 31, 1965

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
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NCTM-USOE

Project for the Improved Use of Newer
Educational Media in Elementary School Mathematics

August 31, 1965

Project Report for Year, July 1, 1964 - August 31, 1965

James H. Zant, Project Director

Advisory Panel: Jack E. Forbes, Chairman, Leslie S. Beatty
Arnold M. Chandler, James E. Stochl

INTRODUCTORY STATEMENT

The original project as conceived by NCTM and USOE was a four-phase project. Phases 1 and 2 were funded for the year July 1, 1964 to June 30, 1965. Upon the completion of Phases 1 and 2, a contract for Phases 3 and 4 was to be negotiated. The contract period for Phases 1 and 2 has since been extended to August 31, 1965, with no additional funding.

The purposes of Phases 1 and 2 of the Project, as stated in the contract, were:

"To identify and state the major objectives of elementary school mathematics and the major concerns and problems, particularly as related to the development and use of newer educational media.

To provide specifications and recommendations for the development and use of newer educational media in elementary school mathematics."

The projected purposes of Phases 3 and 4, as stated in the contract, were:

"To identify and carry out prototype dissemination, demonstration and research activities which will promote wide use and acceptance of newer educational media in elementary school mathematics."

-2-

To accomplish the purposes of Phases 1 and 2, two positional conferences were held. Phase 1 -- the identification and statement of objectives of elementary school mathematics and the relating of these objectives to the development and use of newer media -- was the purpose of the first conference, at the Conrad Hilton Hotel in Chicago on January 14-16, 1965. The second conference, to accomplish Phase 2 -- the provision of specifications and recommendations for the development and use of new media -- was held in the same place on May 13-15, 1965. The recommendations of these conferences for additional phases of the project differed to such an extent from those expected, that the NCTM Advisory Panel for the project decided to consult with the Executive Committee of the NCTM before making recommendations to the USOE for continuation of the project. At a meeting of this Executive Committee on May 20, 1965, it was decided not to request immediate implementation of additional phases of the project. This decision was communicated to USOE prior to June 1, 1965. This report and the decision not to propose immediate activation of Phases 3 and 4 satisfy the conditions of the "Plan of Operation" of the original contract:

"At the conclusion of the (second) conference, the director and advisory panel will prepare a written summary of the two conferences -- in 8 draft copies -- and will confer in person with Office of Education representatives on plans and possible implementation of Phases 3 and 4. This meeting with Office of Education representatives will be held at least one month prior to the termination of the contract." (p. 7 of the contract.)

The rationale for the NCTM decision concerning continuation of this project will be made clear in later sections of this report.

STRUCTURE OF THE TWO POSITIONAL CONFERENCES

These conferences were structured as working conferences. Topics for consideration were determined by the Director and the Advisory Panel. Experts in each area prepared extensive positional

papers well in advance of each conference. These were distributed to and read by the participants prior to the conference. After short introductory statements by the authors of the papers, small group discussion sections discussed the papers and reached a "group position" with respect to the topic. These "group positions" were recorded and distributed to all participants as the basis for discussion sessions involving all those at the conference. From these latter sessions, "conference position statements" evolved.

The lists of conference participants, conference programs, and lists of papers presented are given in the appendix to this report. The "conference position statements" are listed later in this report.

PLANNING FOR THE PHASE 1 CONFERENCE

In line with the objectives of Phase 1, the first conference was structured to accomplish two things:

1. To establish positions concerning the current state of the elementary school mathematics curriculum and the direction it is going and/or should go. (This was interpreted in the broad sense to include teacher training.)
2. To establish a position concerning the current state of newer media for instruction in elementary school mathematics (including teacher training) and to determine future needs with respect to these materials.

There was little difficulty in deciding upon topics, papers, and writers to accomplish the first objective. Papers were included to cover:

- A. Current thinking and research in the content of the curricula of elementary school mathematics, preservice training of teachers, and inservice training of teachers.
- B. Current thinking and research regarding the objectives of elementary school mathematics and the procedure of evaluating the attainment of these objectives.

Since the participants in the first conference were for the most part mathematicians or mathematics educators, it was anticipated that the level of sophistication of the audience with respect to these topics would be high. This proved to be true for A above; true to a lesser extent, for B.

More difficulty was met in determining the method of attaining the objective 2, that is, the establishment of a position concerning the current state of newer media for instruction in elementary school mathematics (including teacher training), and the determination of future needs with respect to these materials. Several alternatives were discussed. These included:

- i. An attempt to evaluate existing materials.
- ii. An attempt to determine the process by which decisions of elementary school to produce or use material presented in a specific medium, are made or should be made.
- iii. Consideration of current projects (research or operational) employing a variety of media in presentation.

Due to the extensive prior activity in the area, it was decided to exclude item i from the formal program. The opportunity for participants to view and informally evaluate some newer films, etc., was provided.

The experience of the Director and the Advisory Panel, together with preliminary investigation, indicated a relative vacuum in ii, except for some research on how this should be done. Thus, the major emphasis in the first conference with respect to the second objective was on iii above.

CONFERENCE POSITIONS - FIRST CONFERENCE

Content of Elementary School Mathematics Curriculum

The conference participants went on record as being in agreement with the general directions of curriculum change, as exemplified by the major study groups and projects which have been active

in the field. They recommended to producers of materials that they use the work of such groups as guidelines with respect to content, avoiding extreme approaches of "fringe area" people or groups. In particular, they emphasized the need for an increased involvement of specialists in content, methodology, evaluation, and learning theory in the design of all materials, regardless of the medium of presentation.

Teacher Training

The conference participants went on record as being in agreement with the Committee on the Undergraduate Program (of the Mathematical Association of America) recommendation (Level I) as the content basis for both preservice and inservice training of teachers of elementary school mathematics. (This recommendation is for approximately 12 semester hours of training in the structure of the real number system and its subsystems, basic concepts of algebra, and informal geometry.)

Use of Newer Educational Media

The participants felt that both producers and users of materials presented in media, other than the printed textbook format, tend to think of these materials as supplementary materials -- not as a part of the "mainstream" of instruction. They urged a rethinking of this position by all concerned. They recommended that consideration be given to determining the unique contribution that each mode of presentation can make to improving the teaching-learning situation. Among the suggestions were:

- Filmstrips as a basic instructional tool

- Films designed to achieve a specific instructional purpose

- Programed texts for individualizing instruction

- Educational television to accelerate curriculum change through teacher training and supplementation of regular classroom instruction

Films of demonstration classes for preservice and inservice teacher education

"Time-compression" films to show concept development and increasing student maturity for teacher education

Ideas which arose in the discussion of this topic, together with four challenging papers on current research in learning theory and "instructional systems,"¹ formed the foundation for what became the dominant theme of the first positional conference and greatly influenced the planning for the second positional conference.

How can this be determined?

How can results be evaluated?

¹The idea of an "instructional system" was introduced into the first conference. This resulted in the following statement in the Final Report of the First Positional Conference:

Now with the possibility of developing many kinds of media with carefully stated objectives, and tested and revised until the particular device actually does modify the behavior of the student, it will be possible to select a set of elements and media to do an effective job of producing learning. The totality of these elements or the "instructional package" for a particular class may include films or videotapes, single concept films, film strips, programmed instruction units and other elements, including teacher presentation at appropriate times. This will be called an instructional system.

This particular idea, in the form stated, developed in the group and conference discussions. The most frequent and persistent contributors to these discussions were probably G. D. Ofiesh, H. W. Walbesser, and L. W. Stolurow.

Later, during the second conference, this definition was further refined. The description of an "instructional system" quoted above led John B. Haney to make the following statement in his Second Positional Paper entitled. "Defining the Tasks of the Administrator and the Roles of the Teacher in the Use of Newer Educational Media in the Schools":

"In reading the report of the First Positional Conference, we find the term 'instructional system' referring to an achievement-validated multi-media package. Missing from the text of the report was an indication of why such a combination should be termed a 'system.'"

Because of this, he made the following definition:

"The instructional system is the term I use for a conceptual framework in which to (a) relate the teacher and other elements of the instruction-learning process and
(See next page)

The Development and Use of Instructional Materials

In the discussion summarized in the preceding section, it was agreed that materials using a variety of media "had a purpose" in the mainstream of instruction. However, the following sequence of questions was raised:

Is it known which medium is best for attaining a given objective?

How can this be determined?

How can results be evaluated?

Are, in fact, the instructional goals of a given grade level or a given sequence of topics stated with sufficient precision to make such evaluation possible?

Finally, can the goals of instruction be stated with sufficient precision that the best procedure for their attainment (or, in fact, whether or not they are attained!) can be determined?

The discussion of these questions became the dominant feature of the conference. From this discussion the following results emerged:

- (a) The participants stressed the importance of stating the objectives of instruction in terms of behaviors which can be measured.² While the majority felt that only

(b) serve as a basis for administrative decision-making regarding the new media of education."

Also, David G. Ryan expresses current usage when he says:

"The word describes an identifiable combination of inter-dependent elements, united by a common information flow network, and operating as an organized whole to produce some characteristic effect or end-product." (Audio-visual Instruction, May 1964.)

² Benjamin S. Bloom (Ed.), Taxonomy of Educational Objectives, The Classification of Educational Goals, Vol. 1, Handbook 1 - Cognitive Domain; Vol. 2, Handbook 2 - Affective Domain, New York, David McKay Company, 1956.

such performance-based statements should be called "instructional objectives," a minority was not willing to forego objectives of a more general, though more subjectively measurable, nature -- e. g., "appreciation", "feeling for", "good attitude toward", etc.

- (b) The participants concurred that a complete agreement on content must precede consideration of the medium to be used to achieve the objectives. They also agreed on the following sequence of activities for the production of any instructional materials:
 - (1) Specify the objectives to be attained in behavioral terms (if possible), and determine the instrument to be used to measure this attainment. Formulate a definition of "acceptable performance."
 - (11) Develop materials intended to provide for individual differences.
 - (111) Test and, if necessary, revise the materials until the required behavior is obtained from the students for which they are intended. (These revisions may include changes in methodology, strategy, medium of presentation, sequence, etc.)

It was at this point that the original concept of this project changed! What began as a project to assess the current state of the use of newer media and to make recommendations for its improved use in elementary school mathematics, changed direction to consider seriously the more basic problem of the decision-making process with respect to instructional objectives and materials production. Exposure to the so-called "instructional systems" approach, in-depth consideration of objectives, and the research reports on multi-media and computer-based "instructional systems" at the first conference made clear the direction of the second positional conference. The need was stated for further exploration of the problems, media and methods involved in the statement of behavioral objectives, selection of alternative strategies for the attainment of these objectives, and the establishment of production procedures for the construction of educational materials. ✓

It must be stated that much of what was "new" to participants of the first conference was not, in fact, new. However, it was

information which had not been widely disseminated. Perhaps the most significant result of the first conference was the "cross-fertilization" accomplished by the involvement in a working conference of mathematics specialists and learning theory and measurement specialists.

PLANNING FOR THE PHASE 2 CONFERENCE

Two things were decided upon as the focal points of the second positional conference. These were:

1. Further in-depth discussion of behavior-based objectives of instruction, with examples from elementary school mathematics.
2. Further discussion of the concept of an "instructional system", with examples of functioning systems (including computer-based systems).

In accordance with the contract for the project, approximately one-third of the participants selected for the second conference were representatives of research and commercial groups working on multimedia material and instructional systems. In addition, approximately one-third were selected from the list of participants of the first conference.

CONFERENCE POSITIONS -- SECOND CONFERENCE

Objectives of Instruction

The position with respect to performance-based objectives was essentially the same as that of the first conference, but more clearly delineated.

1. The statement of all educational objectives in terms of student performance is to be sought.
11. At present there are valid objectives which cannot be so stated. This does not imply that their attainment

should be ignored.

- iii. Research is needed to enable us to state in terms of measurable behavioral goals these presently less precise objectives.

The Systems Approach to Instruction

The amount of commercial activity with respect to computer-based and other instructional systems impressed the participants. So did the appeals from commercial producers for help with respect to the selection of content and statement of objectives of instruction.

This led to the most strongly stated position of the conference participants. This was that there is an urgent need for the development of a structured process by which mathematicians, mathematics educators, learning theorists, measurement specialists, and media specialists can interact in the production of carefully planned instructional materials utilizing (perhaps) a variety of media to achieve specific learning objectives. Such "systems for producing systems" exist on paper. The need expressed was for a "working model" of the process of this production system. This position led to the one major recommendation for the future to come from the conference.

The inclusion of media representatives and participants from the first conference served to broaden the highly successful interaction characteristic of the first conference and to provide continuity between the conferences. As a result of this continuity and a formal review of the positions of the first conference, the position statements and recommendations of the second conference reflect the views of both.

RECOMMENDATIONS

The "systems approach" will have an increasing effect on instruction in elementary school mathematics -- perhaps eventually a dominant effect. It is the responsibility of the mathematics edu-

cational community to assure that this effect is a favorable one.

Commercial and research organizations have developed a structure for producing "systems." They can provide the "hardware" to present the content, make the decisions, etc., which the "systems approach" implies. However, it is the responsibility of the mathematics community to determine what content is to be taught, what goals are to be achieved within this framework of content, and what decisions are to be made.

To exercise this responsibility means to successfully interact with others in "systems development" so that the expertness of each in his field can contribute to the overall success of the system. Systems will be developed -- and they will teach. What they will teach was the concern of both positional conferences. The commitment of mammoth commercial enterprises to this endeavor, coupled with the availability of funds on an unprecedented scale, strongly imply that the materials produced for these systems will find acceptance in the schools. That these materials contain the appropriate content, presented in an appropriate manner to achieve appropriate goals, cannot be determined by computer engineers or learning theorists or media specialists. Still, in the currently existing partial-vacuum caused by minimal involvement in these projects of professional mathematicians and mathematics educators, others are making these determinations.

If the members of the professional mathematical community are to discharge their responsibility to the American school children who will be instructed by these systems, they must become involved now in systems development projects. Such involvement, in order to be successful, demands an understanding of the "systems" approach possessed by few members of the professional mathematics community. It also demands the development of a procedure for successful interaction with those already working in the "systems" field. The immediate initiation of a project to provide this necessary experience and understanding and to develop a workable procedure for such interaction was the one major recommendation of these conferences.

The conferees felt that these objectives -- provision of the opportunity for members of the mathematical community to gain experience in the systems approach and development of a procedure for the successful interaction of various specialists in systems development -- can be attained only through a "working" project. No amount of theoretical discussion can replace the experience gained in the actual development of an instructional system. The system itself is not the goal (as is and will be the case in commercially developed systems). The goals are the development of a procedure for producing an instructional system and the determination of the roles of various specialists in this procedure. The rationale given for the production of such a system is: The only valid test of a production procedure is the quality of its output. The only valid way of measuring the quality of its output is by testing the performance of the system with the children for whom it is intended.

In summary of this thinking:

1. The need is to provide the opportunity for mathematicians and mathematics educators to obtain experience in the development of instructional systems, and to determine a structure within which such people can interact with learning theorists, measurement specialists, media specialists, etc., to produce instructional systems which are sound in content, goals, and methods of presentation.
2. These things can be done only by an active, working project -- more discussions, theorizing, etc., will not help.
3. The success of such a project must be measured in several ways. One of the most important of these is by the quality of the "product" (instructional system) it produces.
4. Thus, such a project must entail the production, testing, etc., of student materials, not as an end but

rather as a means of evaluating the desired end (the achievement of the objectives of the project), provision of experience in the "systems approach," and the development of a structure for systems development.

With this set of goals and this sequence for goal achievement in mind, the conference recommended the following procedure:

1. Statement of Objectives

A team or task force made up of mathematicians, teachers, mathematics educators, learning specialists, measurement specialists, and media generalists should be assembled to:

- a. Select a topic from elementary school mathematics to serve as the content for an instructional system. (The success of this system will serve as the evaluation of the procedures for its production.)
- b. Establish one or more sets of behavioral objectives to be attained by students using the system.
- c. Select methods and strategies for mediating the instruction.
- d. Develop a test instrument and testing techniques to establish the attainment of the stated objectives.

2. Selection of Approaches

When the various parts of 1 have been completed, representatives of the task force will meet with several carefully-chosen media generalists to assign the attainment of specific objectives to specific media. (Several media may be assigned to the attainment of the same objective for comparison purposes.)

3. Production of Learning Materials

The production of these materials must involve mathematicians, teachers, learning theorists, measurement specialists and media specialists. It will be necessary to test and revise these materials until the stated objectives are attained with the intended students.

To say specifically how the stages in this procedure would be carried out would be to preclude the necessity for the project. To determine these stages is, indeed, one of the major objectives of the project. However, some suggestions evolved. These were:

1. The project task force shall take full responsibility for the selection of the topic or topics to be taught, the establishment of the goals for the instruction, and the evaluation of the achievement of these goals.
2. The selection of the approach or approaches shall also be controlled by the task force.
3. The actual production and testing of the materials can be done either by the task force or by existing research facilities (university, private, non-profit, etc.). However, such production and testing must be carried out under task force control to insure that the instructional system produced is refined until the desired goals are achieved with the students for whom the system is intended.

When the production of an effective system has been accomplished and the procedure by which it was produced has been analyzed, two important things will have been done. First, a workable structure for the interaction of mathematicians and other specialists in the production of an instructional system to teach a topic from elementary school mathematics will have been established. Secondly, a number of mathematicians and other specialists skilled and experienced in the type of interaction which is necessary for the production of an effective instructional system will have been developed. A report on the structure, together with the availability of these experienced specialists to (hopefully) continue work in this area, should have an enormous impact on the future of instructional systems in mathematics education.

It was this recommendation which diverted the project from a "collect-disseminate" to a "production" project. This led to the re-examination of the project by the Executive Committee of the NCTM and to their subsequent decision not to request immediate implementation of additional phases of the project.

BIBLIOGRAPHY

Academic Research and Services, Division of. Operational Plans for Developing Regional Educational Research Centers, A Research Report. Pennsylvania State University, University Park, Pa., April 1962.

Adams, J. A. "The Relationship Between Certain Measures of Ability and the Acquisition of a Psychomotor Criterion Response." Journal of General Psychology, 1957, 56, 121-134.

Ahmann, J. S., M. D. Glock, and Helen L. Wardenberg. Evaluating Elementary School Pupils. Boston, Mass.: Allyn and Bacon, Inc., 1960.

Alexander, V. E. "Sex Differences in Seventh Grade Problem Solving." Sch. Sci. and Math, 1962, 62, 47-50.

Ausubel, D. P. "Learning by Discovery: Rationale and Mistique." Bulletin, National Association of Secondary School Principals, 1961, 45, 12.

Banghart, F. W. et al. "An Experimental Study of Programed Versus Traditional Elementary School Mathematics." The Arithmetic Teacher, 1963, 10, 199-204.

Barakat, M. K. "Factors Underlying the Mathematical Abilities of Grammar School Pupils." British Educ. Psychology, 1951, 21, 239-240.

Barson, John, J. M. Gordon, W. R. Hornbaker. "Standard Operating Procedures for a Learning Resources Center: a system for producing systems." Audiovisual Instruction, 1965, 10, 378-9.

Beery Althea. "The Effect of Invironment." Chapter 8, Individualizing Instruction, ASCD Yearbook, NEA, 1201 Sixteenth St., N. W., Washington, D. C., 1964.

Beilin, H. and I. C. Granklin. "Logical Operations in Area and Length Measurement: Age and Training Effects." Child Development, 1962, 33, 607-18.

Bern, H. A. et al. "Reply to Questions About Systems." Audiovisual Instruction, 1965, 10, 366-370.

Blackwell, A. M. "A Comparative Investigation Into the Factors Involved in Mathematical Ability of Boys and Girls." Part I and Part II. British J. Educ. Psychology, 1940, 10, 143-153, 212-222.

Bloom, B. J. (Ed.). Taxonomy of Educational Objectives: Handbook I, Cognitive Domain; Handbook II, Affective Domain. New York: David McKay Co., 1956.

Brackbill, Y. and J. O'Hara. "The Relative Effectiveness of Reward Punishment for Discrimination Learning in Children." J. Comp. Physiol. Psychol., 1958, 51, 747-751.

Briggs, Janet et al. Implementing Mathematics Programs in California, A Guide K-8. Menlo Park, Calif.: Pacific Coast Publishers, 1964.

Briggs, Leslie J. "The Teacher and Programed Learning: Role and Role Potentials." Audiovisual Instruction, 1964, 9.

Brown, Kenneth E. "The New Mathematics - What Are the Changes?" Audiovisual Instruction, 1962, 7.

Bruner, Jerome S. The Process of Education. Cambridge: Harvard University Press, 1960.

Buswell, G. T. (Ed.). "Introduction." The Teaching of Arithmetic. The Fiftieth Yearbook of the National Society for the Study of Education (Part II), Chicago: The University of Chicago Press, 1951.

Cambridge Conference on School Mathematics, Educational Services, Inc. Goals for School Mathematics. Boston: Houghton Mifflin Co., 1963.

Capps, L. R. "Division of Fractions: A Study of the Common-Denominator Method and the Effect on Skill in Multiplication of Fractions." The Arithmetic Teacher, 1962, 9, 10-16.

Cassirer, Henry. Television Teaching Today. UNESCO, 1960.

Chase, C. I. "The Position of Certain Variables in the Prediction of Problem-Solving in Arithmetic." Journal of Educational Research, 1960, 54, 9-14.

Churchman, C. W. "On the Design of Educational Systems." Audio-visual Instruction, 1965, 10, 361-365.

Coleman, R. H. "An Analysis of Certain Components of Mathematical Ability and an Attempt to Predict Mathematical Achievement in a Specific Situation." Diss. Abstr., 1956, 16, 2062.

Corle, C. G. "A Study of the Quantitative Values of Fifth and Sixth Grade Pupils." The Arithmetic Teacher, 1960, 7, 333-340.

Corle, C. G. "Thought Processes in Grade Six Problems." The Arithmetic Teacher, 1958, 6, 186-90.

Coulson, John E. Research With a Program on Geometric Inequalities, Technical Memorandum TM 895/102/00. 2500 Colorado Ave., Santa Monica, Calif.: System Development Corporation, 1964.

Coulson, John E. and Harry F. Silberman. "Effects of Three Variables in a Teaching Machine." Journal of Educational Psychology, 1960, 51, 135-43.

Coulson, John E. and H. F. Silberman. "Results of Initial Experiment in Automated Teaching." In Lumsdaine, A. A. and Glaser, R., Teaching Machines and Programmed Learning. Washington, D. C.: National Education Association, 1960.

Crandall, V. J. and A. Rabson. "Children's Repetition Choices in an Intellectual Achievement Situation Following Success and Failure." J. Genet. Psychol., 1960, 97, 161-168.

Crandall, V. J., D. Solomon, and R. Kellaway. "A Comparison of the Patterned and Non-Patterned Probability Learning of Adolescent and Early Grade School-Age Children." J. Genet. Psychol., 1961, 99, 29-39.

Cronbach, Lee J. "Programed Instruction." NEA Journal, December 1962, 46ff.

Cruickshank, W. M. "Arithmetic Ability of Mentally Retarded Children. Ability to Differentiate Extraneous Materials From Needed Arithmetic Facts." J. Educ. Res., 1948, 42, 161-170.

CUPM of MAA. Course Guides for the Training of Teachers of Elementary School Mathematics. 1962.

CUPM of MAA. Recommendations for the Training of Teachers of Mathematics (A Summary). 1961.

Dale, Edgar. "Technology Is More Than Tools." Educational Leadership, ASCD, NEA, 1201 Sixteenth St., N. W., Washington, D. C.

Deans, Edwina. Elementary School Mathematics, New Directions. OE-29042, Bulletin 1963, No. 13, U. S. Dept. of Health, Education and Welfare. U. S. Government Printing Office, Washington, D. C., 1963.

Dodwell, P. C. "Children's Understanding of Number and Related Concepts." Canad. J. Psychol., 1960, 14, 191-2-5.

Durrell, D. D. "Adapting Instruction to the Learning Needs of Children in the Intermediate Grades." Journal of Education, 1959, 142, 2-78.

Dutton, Wilbur H. Evaluating Pupils' Understanding of Arithmetic. Englewood Cliffs, N. J.: Prentice Hall, Inc., 1964.

Eigen, L. D. and P. K. Komoski. Research Summary of the Collegiate School Automatic Teaching Project. Unpublished Report, 1960.

- Elkind, D. "The Development of Quantitative Thinking: A Systematic Replication of Piaget's Studies." J. Genet. Psychol., 1961, 98, 37-46.
- Elkind, D. "Quantity Conceptions in Junior and Senior High School Students." Child Development, 1961, 32, 551-560.
- Erickson, L. H. "Certain Ability Factors and Their Effect on Arithmetic Achievement." The Arithmetic Teacher, 1958, 5, 287-93.
- Faulk, C. J. and T. R. Landry. "An Approach to Problem-Solving." The Arithmetic Teacher, 1961, 8, 157-160.
- Ferguson, G. A. "On Learning and Human Ability." Canad. J. Psychology, 1954, 8, 95-112.
- Ferguson, G. A. "On Transfer and the Abilities of Man." Canad. J. Psychology, 1956, 10, 121-131.
- Finley, Carmen J. "Arithmetic Achievement in Mentally Retarded Children: The Effects of Presenting the Problem in Different Contexts." Amer. J. Men. Defic., 1962, 67, 281-86.
- Fleishman, E. A. and W. E. Hempel, Jr. "Changes in Factor Structure of a Complex Psychomotor Test as a Function of Practice." Psychometrika, 1954, 19, 239-252.
- Fleishman, E. A. and W. E. Hempel, Jr. "Factorial Analysis of Complex Psychomotor Performance and Related Skills." J. Appl. Psychol., 1956, 40, 96-104.
- Fleishman, E. A. "Factor Structure in Relation to Task Difficulty in Psychomotor Performance." Educ. Psychol. Measmt., 1957, 17, 522-32.
- Fleishman, E. A. and W. E. Hempel, Jr. "The Relation Between Abilities and Improvement with Practice in a Visual Discrimination Reaction Task." J. Exp. Psychol., 1955, 49, 301-312.

Flourney, Frances. Elementary School Mathematics. The Center for Applied Research, Washington, D. C.

Gagne, R. M. and W. E. Paradise. "Abilities and Learning Sets in Knowledge Acquisition." Psychol. Monogr., 1961, 75, No. 14 (Whole No. 518).

Gagne, R. M. "The Acquisition of Knowledge." Psychol. Rev., 1962, 69, 355-365.

Gagne, R. M., J. R. Mayor, H. L. Garstens, and W. E. Paradise. "Factors in Acquiring Knowledge of a Mathematical Task." Psychol. Monogr., 1962, 76, No. 7 (Whole No. 526).

Gagne, R. M. and W. Dick. "Measures in a Self-Instructional Program." Psychological Reports, 1962, 10, 131-46.

Gagne, R. M. and Staff, University of Maryland Mathematics Project. "Some Factors in Learning Non-Metric Geometry." Monograph Soc. Res. Child Development, 1963.

Gagne, R. M. and L. T. Brown. "Some Factors in the Programing of Conceptual Learning." J. Exp. Psychol., 1961, 1962, 313-321.

Gagne, R. M. and Robert C. Bolles. "A Review of Factors in Learning Efficiency." Automatic Teaching (Eugene Callanter, Ed.) New York: Wiley, 1959.

Gibb, E. Glenadine. "Children's Thinking in the Process of Subtraction." J. Exp. Educ., 1956, 25, 71-80.

Goodlad, John I. Planning and Organizing for Instruction. NEA Project on Instruction, 1963, NEA, 1201 Sixteenth St., N. W., Washington, D. C.

Gratch, G. "The Development of the Expectation of the Nonindependence of Random Events in Children." Child Developm., 1959, 30, 217-227.

Gropper, George. "What Should Be Programed for Television?" Trends in Programed Instruction, NEA, Washington, D. C., 1964.

- Guilford, J. P. "The Structure of Intellect." Psychol. Bull., 1956, 53, 267-92.
- Guilford, J. P. "Three Faces of Intellect." Amer. Psychologist, 1959, 14, 469-79.
- Gunderson, R. O. and L. S. Feldt. "The Relationship of Difference Between Verbal and Nonverbal Intelligence Scores to Achievement." J. Educ. Psychol., 1960, 51, 115-121.
- Haworth, Leland, Director, Panel of Educational Research and Development. Innovation and Experiment in Education, A Progress Report. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, March 1964.
- Hodgden, L. H. "Variability of Behavior as a Function of Intelligence and Incentive." J. Pers., 1961, 29, 183-194.
- House, B. J. and D. A. Zeaman. "Transfer of a Discrimination from Objects to Patterns." J. Exp. Psychol., 1960, 59, 298-302.
- Hendrix, Gertrude. "A New Clue to Transfer of Training." Elem. School Journal, 1947, 48, 197-208.
- Hanya, M. "Retardation in Mathematics Amongst Grammar School Pupils." Brit. J. Educ. Psychol., 1952, 22, 189-195.
- Hanlon, C. "Response Variability in Children as a Function of Age, Pretraining and Incentive Conditions." J. Comp. Physiol. Psychol., 1960, 53, 267-269.
- Harlow, H. F. "The Formation of Learning Sets." Psychol. Rev., 1949, 56, 51-65.
- Harshman, H. W., D. W. Wells, and J. N. Payne. "Manipulative Materials and Arithmetic Achievement in Grade 1." The Arithmetic Teacher, 1962, 9, 188-92.

Hartung, Maurice L. "Next Steps in Elementary School Mathematics." Theory and Practice, Bureau of Educational Research and Service, College of Education, Ohio State University, III.. (April 1964) pp. 66-70.

Inhelder, Barbel and J. Piaget. The Growth of Logical Thinking. New York: Basic Books, Inc., 1958.

Izzo, Joseph A. and Ruth Kelley Izzo. "Re-Education in Mathematics for Elementary School Personnel: Inservice Programs--One Way to Solve the Problem." The Arithmetic Teacher, 1964, 11, 413-417.

Jacobs, J. N. and Joan K. Bollenbacher. "Teaching Seventh Grade Mathematics by Television." Mathematics Teacher, 1960, 53, 543-47.

Kalin, R. "The Use of Programed Instruction in Teaching an Advanced Mathematical Topic." The Arithmetic Teacher, 1962, 9, 160-62.

Kendler, H. H., T. S. Kendler, S. S. Pliskoff, and M. F. D'Amato. "Inferential Behavior in Children: I. The Influence of Reinforcement and Incentive Motivation." J. Exp. Psychol., 1958, 55, 207-212.

Landa, L. N. "Training the Pupils in the Methods of Rational Thinking and the Problem of Algorithms." The Prob. of Psychol., 1960, 4, 298-315.

Lewis, Eunice and E. C. Plath. "'Plus' Work for 'Plus' Pupils." The Arithmetic Teacher, 1959, 6, 251-56.

Lipsitt, L. P. and A. Castaneda. "Effects of Delayed Reward on Choice Behavior and Response Speeds in Children." J. Comp. Physiol. Psychol., 1958, 81, 65-67.

Love, T. A. "The Relation of Achievement in Mathematics to Certain Abilities in Problem-Solving." Microfilm Abstr., 1961, 11, 960-962.

- Lovell, K. D. Nealy, and A. D. Rowland. "Growth of Some Geometrical Concepts." Child Development, 1962, 33, 751-767.
- Mager, Robert F. Preparing Objectives for Programmed Instruction. San Francisco: Fearson Publishers, 1962.
- Maltzman, I. "On the Training of Originality." Psychol. Rev., 1960, 67, 229-242.
- Markle, Susan Meyer. "Individualizing Programed Instruction: The Programmer." Teachers College Record, 1964, 66, 3.
- Markle, Susan Meyer. Words. Chicago: Science Research Associates, 1962.
- Mascho, G. "Familiarity with Measurement: A Study of Beginning First-Grade Children's Concepts." The Arithmetic Teacher, 1961, 8, 164-67.
- Maryland Mathematics Project, University of (UMMaP), Mathematics for Elementary Teachers, Book II. College Park, Maryland: UMMaP, 1963.
- Melaragno, Ralph J. Research with an Elementary Arithmetic Program, Technical Memorandum TM 895/101/00. 2500 Colorado Ave., Santa Monica, Calif.: System Development Corporation, 1964.
- Merrill, Irving R. "Research in Media Television." The Improvement of Teaching by Television. Columbia, Missouri: University of Missouri Press, 1964.
- Meyer, W. J. and S. I. Offenbach. "Effectiveness of Reward and Punishment as a Function of Task Complexity." J. Comp. Physiol. Psychol.
- Miller, R. B. and H. P. Van Cott. The Determination of Knowledge Content for Complex Man-Machine Jobs. Pittsburgh: American Institute for Research. 1955.
- Miller, R. B. Handbook on Training and Training Equipment Design. Wright-Patterson Air Force Base, Ohio: Wright Air Development Center. Technical Report 53-136, 1953.

- Newsom, C. V. "Mathematical Background Needed by Teachers of Arithmetic." The Teaching of Arithmetic. (G. T. Buswell, Ed.) The Fiftieth Yearbook of the National Society for the Study of Education (Part II). Chicago: The University of Chicago Press, 1951.
- Oxhandler, E. K. "Afterthoughts on a Systems Conference." Audio-visual Instruction, 1965, 10, 395-397.
- Pace, Angela. "Understanding and the Ability to Solve Problems." The Arithmetic Teacher, 1961, 8, 226-33.
- Penney, R. K. and A. A. Lupton. "Children's Discrimination Learning as a Function of Reward and Punishment." J. Comp. Physiol. Psychol., 1961, 54, 449-451.
- Piaget, J., B. Inhelder and A. Szeminska. The Child's Conception of Geometry. London: Routledge and Kegan Paul, 1960.
- Piaget, J. The Child's Conception of Number. New York: Humanities, 1952.
- Piaget, J. and B. Inhelder. The Child's Conception of Space. London: Routledge and Kegan Paul, 1956.
- Piaget, J. The Child's Construction of Reality. London: Routledge and Kegan Paul, 1955.
- Piaget, J. and B. Inhelder. Le Developpement des Quantites Chez L'Enfant. Neuchatel: Delachaux and Niestle, 1941.
- Piaget, J. and B. Inhelder. La Genese Des Structures Logiques Elementaires. Neuchatel: Delachaux and Niestle, 1959.
- Piaget, J. "How Children Form Mathematical Concepts." Sci. Amer., 1953, 189, 74-79.
- Piaget, J. Les Notions de Mouvement et de Vitesse Chez L'Enfant. Paris: Presses Universitaires de France, 1946.

Miller, R. B. A Method for Man-Machine Task Analysis. Wright-Patterson Air Force Base, Ohio: Wright Air Development Center. Technical Report 53-137, 1953.

Miller, G. A., E. Galanter and K. H. Pribram. Plans and the Structure of Behavior. New York: Holt, 1960.

Miller, R. B. Some Working Concepts of Systems Analysis. Pittsburgh: American Institute for Research, 1954.

Miller, R. B. Task and Part-Task Trainers. Wright-Patterson Air Force Base, Ohio: Wright Air Development Center. Technical Report 60-469, ASTIA No. AD 245652, 1960.

Moise, E. E. Numbers. Mimeograph Document copyrighted by the author.

Moore, O. K. Autoletic Response Environments and Exceptional Children. Responsive Environments Foundation, 1963.

Murray, J. E. "An Analysis of Geometric Ability." J. Psychol., 1949, 40, 118-124.

Muscio, R. D. "Factors Related to Quantitative Understanding in the Sixth Grade." The Arithmetic Teacher, 1962, 9, 258-62.

McAllister, Brigid. "Arithmetical Concepts and the Ability to do Arithmetic." Brit. J. Educ. Psychol., 1951, 21, 155-56.

McIntyre, Charles J. "Some Suggestions for the Application of Learning Theory to Televised Instruction." Paper delivered at the Third NAEB Conference on Televised Instruction, Miami, Florida, May 10, 1964.

Newmark, Gerald. Research in Programmed Instruction in Seventh-Grade Spanish, Technical Memorandum TM 895/103/00. 2500 Colorado Ave., Santa Monica, Calif.: System Development Corporation, 1964.

Pitts, R. J. "Relationships Between Functional Competence in Mathematics and Reading Grade Levels, Mental Ability, and Age." J. Educ. Psychol., 1952, 43, 486-492.

Polya, G. How to Solve It; A New Aspect of Mathematical Method. Garden City, New York: Doubleday, 1957.

Programs '63 - A Guide to Programed Instructional Materials. U. S. Office of Education OE-34015-63. U. S. Government Printing Office, Washington, D. C., 1963.

Provus, M. M. "Ability Grouping in Arithmetic." Elem. School J., 1960, 60, 391-98.

Reynolds, B. "The Effect of Learning on the Predictability of Psychomotor Performance." J. Exp. Psychol., 1952, 44, 189-198.

Rhodes, Lewis A. "The Double Standard: Are We Failing Our Schools in an Age of Technology?" Michigan Education Journal, March 1964.

Roe, V. V., H. W. Case, and A. Roe. Scrambled vs. Ordered Sequence in Auto-Instructional Programs. Los Angeles: University of California, Department of Engineering Report No. 61-48, May, 1961.

Ryan, David G. "Programed Learning in Relation to Theory of Instruction." Audiovisual Instruction, 1964, 9.

Schell, L. M. and P. C. Burns. "Pupil Performance with Three Types of Subtraction Situations." Sch. Sci. and Math., 1962, 62, 208-214.

School Mathematics Study Group, Report of a Conference on Elementary School Mathematics, Chicago, Illinois, 1959.

Schramm, Wilbur S. The Research on Programed Instruction, An Annotated Bibliography. USOE, OE 34034, Bulletin, 1964, No. 35, Washington, D. C., U. S. Government Printing Office, 1964.

Schult, Veryl. Inservice Mathematics Education, Promising Practices for Elementary and Secondary School Teachers. OE-29056, Bulletin 1964, No. 36, Washington, D. C., U. S. Government Printing Office, 1964.

Schure, Alexander. "Educational Escalation Through Systems Analysis." Audiovisual Instruction, 1965, 10, 371-377.

Scott, Carrie M. "The Relationship Between Intelligence Quotients and Gain in Reading Achievement with Arithmetic Reasoning, Social Studies, and Science." J. Educ., 1963, 56, 322-26.

Shettel, H. H., D. Angel and A. A. Lumsdaine. Self-Instructional Programs for SAGE Systems Operators. Final Report AIR-C-11-61, FR-252. Pittsburgh: American Institute of Research, 1961.

Shine, Aileen. "Relationship Between Arithmetic Achievement and Item Performance on the Revised Stanford-Binet Scale." The Arithmetic Teacher, 1961, 8, 57-59.

Silberman, H. F. Exploratory Research on a Beginning Reading Program. Technical Memorandum TM 895/100/00. 2500 Colorado Avenue, Santa Monica, Calif.: Systems Development Corporation, 1964.

Silberman, H. F., J. E. Coulson, R. J. Melaragno, and G. Newmark. Use of Exploratory Research and Individual Tutoring Techniques for the Development of Programming Methods and Theory. Technical Memorandum TM 895/200/00. 2500 Colorado Avenue, Santa Monica, Calif.: System Development Corporation, 1964.

Snader, Daniel W. The Leadership Role of State Supervisors of Mathematics. OE-29032, Bulletin 1962, No. 1, Washington, D. C.: U. S. Government Printing Office, 1962.

Stevenson, H. W. and G. McBee. "The Learning of Object and Pattern Discriminations by Children." J. Comp. Physiol. Psychol., 1958, 51, 752-754.

Stevenson, H. W. and M. W. Weir. "Variables Affecting Children's Performance in a Probability Learning Task." J. Exp. Psychol., 1959, 57, 403-412.

Stolurrow, L. M. and F. R. Newman. "A Factorial Analysis of Objective Features of Printed Language Presumably Related to Reading Difficulty." J. Educ. Res., 1959, 52.

Stolurrow, L. M. "Social Impact of Programed Instruction: Aptitudes and Abilities Revised." In J. P. De Cecco (Ed.) Educational Technology: Readings in Programed Instruction. New York: Holt, Rinehart and Winston, 1964, 348-355.

Stolurrow, L. M. Teaching by Machine. OE-34010, Cooperative Res. Monogr., No. 6, Washington, D. C.: U. S. Government Printing Office, 1961.

Stolurrow, L. M. and D. J. Davis. "Teaching Machines and Computer Based Systems." In R. Glaser (Ed.) Teaching Machines and Programed Learning: Data and Directions (In press).

Stolurrow, L. M. "Teaching Machines and Programed Instruction." In B. Biddle and P. Rossi (Eds.) The Impact of the New Media on Education and the Society. (In press).

Stolurrow, L. M. "Teaching Machines and Programed Instruction." The American Behavioral Scientist, 1962, VI, 3.

Swineford, Frances. "General, Verbal, and Spatial Bi-factors After Three Years." J. Educ. Psychol., 1949, 40, 353-60.

Szent, Gyorgyi, Albert. "Teaching and the Expanding Knowledge." Science, 1964, 146, 1278-79.

Travers, Robert M. W. "Transmission of Information to Human Receivers." American Educational Psychologist, 1964, 2, 1.

Travers, Robert M. W. (Ed.). Research and Theory Related to Audio-Visual Information Transmission. Salt Lake City: Bureau of Educational Research, University of Utah. July 1964.

Tomber, M. L. and John Wagner. Algebra. Berkeley, Calif.: Committee on the Undergraduate Program in Mathematics, 1964.

Tabe, Hilda. Curriculum Development-Theory and Practice. New York: Brace and World, 1962.

Terrell, G. "The Role of Incentive in Discrimination Learning in Children." Child Development, 1958, 29, 231-236.

Terrell, G. K. Durkin, and M. Wiesley. "Social Classes and the Nature of the Incentive in Discrimination Learning." J. Abnorm. Soc. Psychol., 1959, 59, 270-272.

Terrell, G. and W. A. Kennedy. "Discrimination Learning and Transportation in Children as a Function of the Nature of the Reward." J. Exp. Psychol., 1957, 53, 257-260.

Wagner, John. Mathematics Text Materials for the Undergraduate Preparation of Elementary School Teachers. CUPM Study No. 2, Berkeley, Calif.: Committee on the Undergraduate Program in Mathematics, 1963.

Weiss, Paul. "Knowledge: A Growth Progress." Science, 1960, LXXXI, 1716-19.

Woodrow, H. "The Effect of Practice on Groups Different In Initial Ability." J. Educ. Psychol., 1938, 29, 268-278.

Woodrow, H. "The Ability to Learn." Psychol. Rev., 1946, 53, 147-158.

Wohlwill, J. F. and R. C. Lowe. "Experimental Analysis of the Development of the Conservation of Number." Child Development, 1962, 33, 153-67.

Wallen, Norman Earle and R. O. Nowles. "Effects of Intraclass Ability Grouping on Arithmetic Achievement in the Sixth Grade." J. Educ. Psychol., 1960, 51, 159-63.

Walbesser, H. H. "Curriculum Evaluation by Means of Behavioral Objectives." J. Res. Sci. Teach., 1963, 1, 296-301.

Project for the Improved Use of Newer
Educational Media in Elementary School Mathematics

James H. Zant, Project Director
Oklahoma State University

August 31, 1965

List of Films on Mathematics for Elementary School Teachers

1. Mathematics for Elementary School Teachers 1963-4

To be used with a textbook written by Dr. Dwight.

Teacher: Prof. L. A. Dwight. Producer: Southeastern State
College, Durant, Oklahoma. 90 thirty-minute films.
Sponsored by NSF.

2. Patterns in Mathematics, First Year High School Algebra. 1960-61

Traditional content utilizing the new teaching point of view.
Useful for in-service teacher education. Includes teacher's
guide and pupil's exercise book, both essential in using the
telecourse.

Teacher: Prof. Donovan R. Lichtenberg. Course Consultant: Henry
Van Engen. Producer: Wisconsin School of the Air. 76
twenty-five minute video tape lessons. Sponsored by
Ford Foundation.

3. Modern Mathematics.

For junior high school teachers, but could be useful for ele-
mentary school teachers. Logical structure of number system,
postulational approach to algebra and theorems of arithmetic.

Teacher: Louis F. Scholl. Producer: WNED-TV, New York State
Department of Education. 30 videotapes, 30 minutes
each.

4. Patterns in Arithmetic, Grades 4, 5, and 6.

For elementary school children, but each set includes 12
teacher lessons. They are being revised and extended to in-

clude grades 1-6. 29 1/2 minutes. Videotapes and kinescopes.

Teacher: Miss Marilyn Zweng and Henry Van Engen. Producer: Wisconsin School of the Air.

5. Sets and Systems. Videotape

15 thirty minute lessons for elementary school teachers. Covers too much ground, groups at end of lesson 13! Some mathematical errors.

Teacher: Miss Elizabeth Boisclair, former high school teacher, Washington, D. C. public schools. Producer: Greater Washington Educational Television Association.

6. Foundations of Mathematics for Elementary School Teachers

Teachers: E. Glenadine Gibb and Augusta L. Schurrer

Producer: State College of Iowa, Cedar Falls. Sponsored by NSF.

7. Florida Mathematics TV Project, Modern Mathematics for Elementary School Teachers

Started May 1, 1965; by January 1966, will have 30 thirty-minute tapes. Some tapes now complete (August 1965). Will be used beginning January 1966, in a massive inservice program involving the state's 25,000 elementary school teachers.

Teacher: Robert Kalin, Florida State University. Producer: Florida State University, WFSU-TV.

8. Mathematics for Elementary School

To be used in connection with Vol. IX, SM30; includes geometry with real number system. 30 thirty-minute films.

Teacher: Stewart Moredock, Sacramento State College. Producer: SM30.

9. Teaching Mathematics K-6

Covers basic concepts of number with some geometry and something on methods. Includes manual for students. 15 thirty-minute kinescopes.

Teacher: Sister M. Leontius, O. S. F. Producer: College of St. Teresa, Winona, Minn.

10. Challenges in Elementary School Arithmetic

For elementary school teachers. Three one-half hour kinescopes. Useful for short workshops for elementary school teachers.

Teacher: Edwina Deans, USOE Specialist in Mathematics
Producer: University of Washington KTV Station. Available for loan by the Washington State Office of Public Instruction, Olympia.

11. Understanding Rational Numbers

A series of 26 one-half hour lessons for elementary teachers.

Teacher: Dr. Arden Raddell, Professor of Education, University of California, Berkeley. Producer: California Bureau of Elementary Education, Sacramento.
Information on availability from Robert S. Shute, NEHA Consultant, Bureau of Elementary Education, California State Department of Education, Sacramento.

12. Mathematics for Teachers

A series of 89 kinescopes produced 1958-59 for N. Y. Regents KTV project. Secondary level.

Teacher: Harry Ruderman. Producer: The University of the State of New York, The State Education Department, Albany.

13. Contemporary Mathematics (for elementary school teachers) 1962-63

Thirty week series for inservice training, covering content and approaches to mathematics which will be of value to elementary teachers as they adapt teaching methods in light of recent curriculum developments.

Teachers: Alene B. Archer and Joseph L. Lacy
Producer: WETA-TV, Yorktown High School, 5201 26th Street, N, Arlington 7, Virginia.

14. Interpreting Modern Mathematics, Grades K-6 1962

Thirteen programs designed to provide inservice education for teachers K-6. Deals with content, materials, and methods of teaching modern mathematics.

Teacher: Not listed. Producer: KVMF-TV, Channel 8, San Diego, California.

15. Let's Solve It 1960-61

An enrichment program for classroom use, but provides much incidental inservice training. 27 twenty-minute lessons for fifth grade students.

Teacher: Joseph Murray, San Francisco State College. Producer: IGED, Instructional Television Service. Bay Region Instructional Television Mathematics Committee, 325 Fourth Street, San Francisco 7, California.

16. Modern Mathematics for Elementary School Teachers. (as of indicated)

Television inservice materials for special problems in the teaching of mathematics.

Teacher: Oscar Schaaf, Head Mathematics Department, South Eugene High School, Eugene, Oregon. Producer: College of the Air, General Extension Division, Oregon State System of Higher Education, Salem, Oregon.

APPENDIX

**Conference Program
List of Participants**

PRECEDING PAGE BLANK. NOT FILMED

Project for the Improved Use of Newer
Educational Media in Elementary School Mathematics

Sponsored by
The National Council of Teachers of Mathematics

FIRST POSITIONAL CONFERENCE

Conrad Hilton Hotel, Chicago
January 14, 15, and 16, 1965

PROGRAM FOR THE CONFERENCE

Thursday, January 14

10:00AM - 1:00 PM

Registration, Meeting Room 14, Second Floor,
North

1:00 PM - 1:45 PM

General Meeting, Meeting Room 19, Second
Floor, North

Brief Introductory Statement

James E. Zant, Project Director

Brief Discussion of Papers on Topic 1: The
Content and Organization of Elementary
School Mathematics

Gerald Rising, University of Minnesota

Elaine Evans, U. S. Office of Education

1:45 PM - 2:45 PM

Meeting of Discussion Groups

No. I-Meeting Room 19, Leader, Robert
Kalin

Recorder: Stanley F. Brown

Consultant: William T. Guy

No. II-Meeting Rm. 18, Leader: Father
Stanley Bruscia

Recorder: Irene St. Clair

Consultant: J. E. Glover

No. III-Meeting Rm. 15, Leader: Wade Ellis

Recorder: Glyn E. Sharpe

Consultant: Henry E. Walbesser

No. IV-Meeting Rm. 12, Leader: Charles Brunfiel

Recorder: Robert Clary

Consultant: Merlin M. Ohmer

2:45 PM - 3:15 PM

Coffee Break - Meeting Room 14

3:15 PM - 5:00 PM

General Meeting, Meeting Rm. 19, James H. Tant, Presiding

Recommendations of Discussion Groups,
3:15 - 4:00 PM

General Discussion: 4:00 - 5:00 PM

7:30 PM - 10:00 PM

Meeting Room 14

No formal evening program is scheduled. However, there will be on display samples of new media and materials now available for elementary school mathematics. These will include books, films, kineoscopes, video tapes, film strips, and other media. Facilities will be available for viewing these media and it is hoped that participants of the conference will take advantage of this period for this purpose and for informal discussions.

Friday, January 19

8:30 AM - 9:00 AM

General Meeting, Meeting Rm. 19, Jack Forbes, Presiding

Brief Discussion of Papers on Topic 2: Learner Characteristics Which Are Relevant to Consider in the Teaching of Elementary School Mathematics

L. W. Stolarow, Univ. of Illinois

Henry H. Walbesser, Jr., Univ. of Maryland and AAAS

9:00 AM - 10:00 AM

Meeting of Discussion Groups

No. I - Meeting Rm. 19, Leader: William T. Guy

Recorder: Wm. Coffie

Consultant: Gerald Rising

No. II - Meeting Rm. 18, Leader: John Wagner

Recorder: Robert Shute

Consultant: Father Stanley

Rezuska

No. III - Meeting Room 13, Leader: Edvina Deans

Recorder: Irene Mathews

Consultant: Wade Ellis

No. IV - Meeting Rm. 12, Leader: Brother James F. Gray

Recorder: James D. Gates

Consultant: Leon Hibbs

10:00 AM - 10:30 AM

Coffee Break - Meeting Room 14

10:30 AM - 12:00 Noon

General Meeting - Meeting Rm. 19, Jack Forbes,
Presiding

Recommendations of Discussion Groups,

10:30 - 11:00 AM

General Discussion, 11:00 - 12:00 AM

12:15 PM - 1:15 PM

Lunch, Private Dining Room

1:30 PM - 2:00 PM

General Meeting, Meeting Rm. 19, James E. Stochl, Presiding

Brief Discussion of Papers on Topic 3: The Preparation of Teachers of Elementary School Mathematics

Robert E. Willson, Washington State
Supervisor of Mathematics

John Wagner, Michigan State University

2:00 PM - 3:00 PM

Meeting of Discussion Groups

No. I - Meeting Rm. 19, Leader: Gerald R. Rising

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Recorder: Stanley P. Brown

Consultant: Sister Leontius

No. II-Meeting Rm. 18, Leader: Irene
St. Clair

Recorder: Eunice Lewis

Consultant: Sheldon Myers

No. III-Meeting Room 13, Leader: Leslie
A. Dwight

Recorder: Glyn Sharpe

Consultant: Edwina Deans

No. IV-Meeting Room 12, Leader: Leon
Hibbs

Recorder: Charles Brunfield

Consultant: Bro. James F. Gray

3:00 PM - 3:30 PM

Coffee Break - Meeting Room 14

3:30 PM - 5:00 PM

General Meeting, Meeting Rm. 19, James E.
Stochl, Presiding

Recommendations of Discussion Groups,

3:30 - 4:15 PM

General Discussion, 4:15 - 5:00 PM

7:30 PM - 10:00 PM

Viewing and Informal Discussion, Meeting
Room 14

Saturday, January 16

8:30 AM - 9:00 AM

General Meeting, Meeting Room 19, Arnold
Chandler, Presiding

Brief Discussion of Papers on Topic 4: The
Effectiveness of Educational Media in the
Teaching of Elementary School Mathematics
Colonel Gabriel D. Ofiesh, USAF, Wash-
ington, D. C.

Robert Kalin, Florida State University

9:00 AM - 10:00 AM

Meeting of Discussion Groups

No. I - Meeting Room 19, Leader: Robert
Willson

Recorder: Wm. Coffia

Consultant: Robert Kalin

No. II - Meeting Room 18, Leader: Eunice Lewis

Recorder: John Wagner

Consultant: Robert Shute

No. III - Meeting Rm. 13, Leader: Vernon Price

Recorder: Irene Mathews

Consultant: H. H. Walbesser, Jr.

No. IV - Meeting Rm. 12, Leader, Robert Clary

Recorder: Frank Hawthorne

Consultant: L. W. Stolurov

10:00 AM - 10:30 AM

Coffee Break - Meeting Room 14

10:30 AM - 12:00 Noon

General Meeting - Meeting Rm. 19, Arnold Chandler, Presiding

Recommendations of Discussion Groups,
10:30 - 11:00

General Discussion, 11:00 - 12:00

12:15 PM - 1:15 PM

Lunch, Private Dining Room

1:30 PM - 1:45 PM

General Meeting, Meeting Room 19, Leslie Beatty, Presiding

Brief Discussion of Paper on Topic 5: The Status of the New Educational Media in the Teaching of Elementary School Mathematics as Revealed in Reports and Summaries of Established Programs

Robert Shute, Calif. State Dept. of Education

1:45 PM - 2:30 PM

Meeting of Discussion Groups

No. I - Meeting Rm. 19, Leader: Sister Leontine

Recorder: Robert Willson

Consultant: Bruce Messers

No. II - Meeting Rm. 18, Leader: Israel

Glover

Recorder: Sheldon Myers

Consultant: Col. G. D. Ofiesh

No. III - Meeting Rm. 13, Leader: Henry

Walbesser

Recorder: Vernon Price

Consultant: Glyn H. Sharpe

No. IV - Meeting Rm. 12, Leader: James D.

Gates

Recorder: Merlin M. Ohmer

Consultant: Frank Hawthorne

2:30 PM - 3:00 PM

Coffee Break - Meeting Room 14

3:00 PM - 5:00 PM

General Meeting, Meeting Rm. 19, Leslie

Beatty, Presiding

Recommendations from the Discussion Groups

3:00 - 3:30

General Discussion on the Outcomes of the

Conference, 3:30 - 5:00 PM, Jack Forbes,

Presiding

5:00 PM

Conference Adjourns

Project for the Improved Use of Newer
Educational Media in Elementary School Mathematics

Sponsored by
The National Council of Teachers of Mathematics
and
The United States Office of Education

SECOND POSITIONAL CONFERENCE
Conrad Hilton Hotel, Chicago
May 13, 14 and 15, 1965

PROGRAM FOR THE CONFERENCE

Thursday, May 13

8:00 AM - 9:15 AM

Registration, Private Dining Room 14, Fourth Floor, North

9:30 AM - 12:00 Noon

General Meeting, Private Dining Room 19, Fourth Floor, North

Introduction to the Project

Jack E. Forbes, Chairman, Advisory Panel

Keynote Speech, Classroom Activities in Relation to Goals for
School Mathematics in the Elementary School

Carroll V. Hayson, Radio Corporation of America

Discussion from the floor

12:15 - 1:15 PM

Luncheon, Bel Air Room

1:30 - 2:30 PM

General Meeting, Room 19, Arnold Chandler, Presiding

Brief Presentation of the Papers:

1. Performance-Based Behaviors as a Basis for Stating
Objectives, Constructing Criterion Tests and Assessing
Results of Learning Materials for Elementary School
Mathematics.

David Cras, Audio-Visual Services,
San Jose State College

2. Examples of Using Performance-Based Behaviors for

Stating Objectives for Topics from Elementary Mathematics.

Helen L. Garstens, University of Maryland

2:30 - 4:30 PM

Meeting of Discussion Groups

(Coffee and soft drinks will be served in the Discussion rooms at 3:15 PM)

No. I - Private Dining Room 17

Leader: To be selected

Recorder: To be selected

Consultants: Speakers and Advisory Panel

No. II - Private Dining Room 18

Leader: To be selected

Recorder: To be selected

Consultants: Speakers and Advisory Panel

7:30 - 9:30 PM

Meeting of Discussion Group Leaders and Recorders, Rooms 17, 18

For purpose of making preliminary reports on the discussion groups to be duplicated and distributed to both discussion groups at 10:15 AM, Friday morning. The reports should be ready for the typist (Room 14) by 8 AM, Friday.

A film, Programmed Instruction, the Development Process, by David Markle, will be shown at 8:00 PM, in Room 14.

Friday, May 14

9:00 AM - 10:00 AM

General Meeting, Room 19, Leslie S. Beatty, Presiding

Defining the Tasks of the Administrator and the Roles of the Teacher in the Use of the New Educational Media in the School.

John B. Haney, Director

Office of Instructional Resources, University of Illinois
at Chicago Circle

Discussion from the floor

M - 12:00 Noon Meeting of Discussion Groups

No. I - Room 17

No. II - Room 18

Same discussion leader and recorder.

Coffee, etc., served at 10:20

M - 1:15 PM Luncheon, Bel Air Room

M - 3:00 PM General Meeting, Room 19, James Stochl, Presiding
Potential of Computer Based Instruction in Elementary School Mathematics.

R. Louis Bright, Director of Instructional Technology
Research and Development Center, Westinghouse Electric Corp.

Reports on Existing Programs:

Mathematics for Grade One

Ralph Melareagno, Systems Development Corporation
Santa Monica, California

Computer Assisted Instruction in Elementary School Mathematics
Leander W. Smith, Science Research Associates

Discussion from the floor.

PM - 4:30 PM Discussion Groups

No. I - Room 17

No. II - Room 18

Coffee, etc., served at 3:15

PM - 9:30 PM Meeting of Discussion Group Leaders and Recorders, Rooms 17, 18
To complete reports on recommendations of the discussion groups. These will be presented to the entire conference at 10:30 AM, Saturday. The Reports should be ready for the typist by 8 AM, Saturday.
Presentation on 8 mm Film Loops - Carolyn Grinnell, Project in Educational Communication, Teachers College, Columbia University.

Saturday, May 15

9:00 AM - 10:15 AM

General Meeting, Room 19, James H. Paul, Presiding
Reports on Problems in the Development and Production of In-
structional Materials in Media for Elementary School Mathematics
Julius H. Slavaty, NCN Film Project
Erling Jorgensen, Midwest Program on Airborne Television In-
struction

Discussion from the floor.

10:15 AM - 10:30 AM

Coffee

10:30 AM - 12:30 PM

Recorders' Reports
Summary and Conclusions

12:30 PM

Conference Adjourns

2:00 PM through
May 16

Meetings of Advisory Panel and others to write final report
on the Project

Project for the Improved Use of New
Educational Media in Elementary School Mathematics

List of Invited Participants, First Conference, January 14-16, 1969

Bruce E. Henshaw, Ex officio
President, NCDE

Mrs. Leslie S. Beatty, Supervisor
Chula Vista, Calif. School District

Rev. Stanley J. Decuska, S. J.
Boston College

Stanley F. Brown
State Supervisor of Mathematics
Augusta, Maine

Charles Brunfiel
University of Michigan

Arnold W. Chandler
Wisconsin State Supervisor of
Mathematics

Robert Clary
Director of Mathematics
Raleigh Rapids, North Carolina

William Coffie
Supervisor of Mathematics
Oklahoma City Public Schools

Edwin Deane, Specialist in Ele-
mentary School Mathematics
U. S. Office of Education

Leslie A. Dwight
Southeastern State College
Durant, Oklahoma

Wade Ellis
Oberlin College

Jack E. Forbes
Purdue University
Calumet Campus

James D. Gates, Exec. Sec.
National Council of Teachers of
Mathematics

I. E. Giger
Florida A. and M. Univ.

Bro. James F. Gray, S. M.
Superior of Schools
Society of Mary
St. Louis 22, Missouri

William T. Guy, Jr.
University of Texas

Frank S. Hathorne
New York State Supervisor,
Mathematics Education

Leon Hibbs
Oklahoma City University

Ruth Huffman
University of Denver

Robert Kalia
Florida State University

Sister M. Leontine
College of St. Teresa
Winona, Minnesota

Eunice Lewis
University of Oklahoma

Irene A. Mathews
Elementary School Teacher
Tallahassee, Florida

Sheldon S. Myers
Educational Testing Service

Colonel G. D. Offish, USAF
Alexandria, Virginia

Merlin M. Obner
University of Southwestern
Louisiana
Lafayette, La.

Vernon Price
University of Iowa

Cerald R. Rising
University of Minnesota

Glyn E. Sharpe, Consultant
Science and Mathematics
Colorado State Dept. of Education

Robert S. Shute
Bureau of Elementary Education
Calif. State Dept. of Education

Irene St. Clair
Consultant in Mathematics
Texas Education Agency

James E. Stockl
University of Minnesota

L. W. Stolarow
Training Research Laboratory
University of Illinois

John Wagner
Michigan State University

Henry E. Walbecker, Jr.
AAAS and University of Maryland

Robert E. Willson
Supervisor, Mathematics Program
Washington State Dept. of Public
Instruction

NCM-EDCE

Project for the Improved Use of Better
Educational Media in Elementary School Mathematics

List of Invited Participants for the Second Positional Conference .

May 11-13, 1962

Wm. Leslie S. Beatty, Supervisor
Chula Vista, Calif. School District

R. Louis Bright
Research and Development Center
Westinghouse Electric Corp.
Pittsburgh 35, Pa.

Arnold W. Chandler
Dept. of Public Instruction
Madison, Wisconsin

Robert Clary
Roanoke Rapids, N. C.

David Cram
Audio-Visual Service Center
San Jose State College

Robert W. Diamond
Director of Instructional Resources
University of Miami

Marion G. Epstein
Educational Testing Service

Jack E. Fortee
Purdue University
Calumet Campus

Francis Frederick
Department of Education
Oklahoma State University

Helen L. Garstens
University of Maryland

Brewster H. Gere
Hamilton College

Bro. James F. Gray, S. M.
Supervisor of Schools
Society of Mary

Carolyn Grinnell
Project in Educational Communica-
tion

Teachers College, Columbia Univ.

John B. Hany
University of Illinois
Chicago Circle

Julius E. Hlevaty
NCM-MET Film Project

Charles R. Bucka
NCM National Office

Conover A. Johnson
University of Minnesota

Phillip S. Jones
University of Michigan

Erling Jorgensen
NSAT
Purdue University

Bonnie Lewis
University of Oklahoma

Ralph J. Malaragno
System Development Corp.
Santa Monica, Calif.

Carroll V. Newcom
Candlewood Isle
New Fairfield, Conn.

Isabelle P. Rucker
Supervisor of Mathematics
Richmond, Virginia

Joseph F. Senta
McGraw-Hill Book Co.

Olyn H. Sharpe
Science and Mathematics Consultant
Denver 8, Colorado

Leander W. Smith
Science Research Associates
Burlington, Vermont

James E. Stockl
University of Minnesota

Irene St. Clair
Texas Education Agency

John Wagner
Michigan State University

Robert H. Wilson
State Supervisor of Mathematics
Olympia, Washington

James H. Zant, Project Director
Oklahoma State University

Joseph S. Bowers
Encyclopedia Britannica Press